UNIVERSITY OF CALIFORNIA PUBLICATIONS

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

RESULTS OF RICE EXPERIMENTS IN 1922

BY
CARROLL F. DUNSHEE

BULLETIN No. 354
FEBRUARY, 1923

Group of rice growers visiting experimental tract at Cortena in September, 1922, just before draining the checks.

UNIVERSITY OF CALIFORNIA PRESS
BERKELEY, CALIFORNIA
1923

David P. Barrows, President of the University.

EXPERIMENT STATION STAFF

HEADS OF DIVISIONS

Thomas Forsyth Hunt, Dean.
Edward J. Wickson, Horticulture (Emeritus).
——— ———, Director of Resident Instruction.
C. M. Haring, Veterinary Science, Director of Agricultural Experiment Station.
B. H. Crocheron, Director of Agricultural Extension.
C. B. Hutchison, Plant Breeding, Director of the Branch of the College of Agriculture, Davis.
H. J. Webber, Citriculture, Director of Citrus Experiment Station.
William A. Setchell, Botany.
Myer E. Jaffa, Nutrition.
Ralph E. Smith, Plant Pathology.
John W. Gilmore, Agronomy.
Charles F. Shaw, Soil Technology.
John W. Gregg, Landscape Gardening and Floriculture.
Frederic T. Bioletti, Viticulture and Fruit Products.
Warren T. Clarke, Agricultural Extension.
Ernest B. Babcock, Genetics.
Gordon H. True, Animal Husbandry.
James T. Barrett, Plant Pathology.
Walter Mulford, Forestry.
W. P. Kelley, Agricultural Chemistry.
H. P. Quayle, Entomology.
Elwood Mead, Rural Institutions.
H. S. Reed, Plant Physiology.
L. D. Batchelor, Orchard Management.
W. L. Howard, Pomology.
*Frank Adams, Irrigation Investigations.
C. L. Roadhouse, Dairy Industry.
R. L. Adams, Farm Management.
W. B. Herms, Entomology and Parasitology.
John E. Dougherty, Poultry Husbandry.
D. R. Hoagland, Plant Nutrition.
G. H. Hart, Veterinary Science.
L. J. Fletcher, Agricultural Engineering.
Edwin C. Voorhies, Assistant to the Dean.

DIVISION OF IRRIGATION INVESTIGATIONS AND PRACTICE

Frank Adams
S. H. Beckett
F. J. Veihmeyer
C. M. Titus
H. A. Wadsworth
C. F. Dunshee
Martin R. Huberty
Frank Davis
Clarence N. Johnston
J. B. Brown (Extension Specialist)

* In coöperation with Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture.

RESULTS OF RICE EXPERIMENTS IN 1922

By CARROLL F. DUNSHEE

Rice Specialist, Division of Irrigation Investigations and Practice.

CONTENTS

PAGE

Preparation of Field and Seeding 403
Effects of Seeding and Submergence on Water-Grass Control 403
Effect of Date of Seeding and Submergence on Water-Grass Control and Rice Yields 406
Miscellaneous Experiments 406
Water and Soil Analyses 408
Rice Weeds 410

This bulletin is a progress report on rice experiments conducted near Cortena, Colusa County, during the growing season of 1922, under the auspices of the California Agricultural Experiment Station.* The experiments were devoted entirely to cultural problems on old land and had mainly to do with control of water grasses through manipulation of irrigation. A small beginning was also made in a series of crop rotation and other miscellaneous experiments. The work was conducted on forty-five acres of land leased from the Esperanza Land Corporation and located one-fourth mile east of

* These experiments were made possible through a special allotment of $10,000 provided by the Legislature of 1921 at the request of the rice growers of the Sacramento Valley made through the California Agricultural Legislative Committee. The experiments were planned and supervised by the following committee appointed by the Director of the Experiment Station: Frank Adams, chairman, P. L. Hibbard, J. W. Jones (Superintendent of the Biggs Rice Field Station of the Bureau of Plant Industry), P. B. Kennedy, W. W. Mackie, C. F. Shaw, and W. W. Weir. Messrs. J. H. Harland of Woodland, O. E. Squires of Willows, and H. S. Brink of Biggs were growers appointed by President Ralph P. Merritt of the Rice Growers Association to coöperate with the Experiment Station. Mr. Bert Anderson and Messrs. George and Raymond Houx, neighboring rice growers, were helpful throughout the season. Irrigation water was furnished free by the Glenn-Colusa Irrigation District.

Since the work reported in this bulletin gives the results of experiments during one season only, the drawing of conclusions is postponed until the experiments have extended over a longer period.

Cortena (fig. 1). This land had been in rice for the four previous seasons and was considered by its owners too foul for profitable culture a fifth season.

In addition to the experiments at Cortena, P. L. Hibbard made some examinations of the alkalinity of water entering and leaving the field at Cortena and rice fields at several points in the valley, and

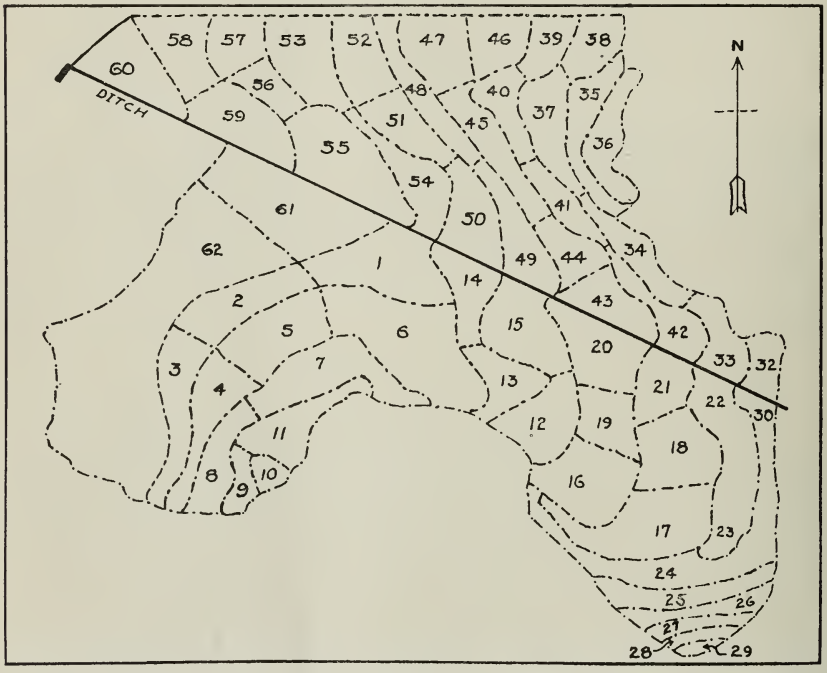

Fig. 1.—Map of temporary rice experiment station, Cortena, showing arrangement and location of plots.

C. F. Shaw and assistants began a study of the effect of rice growing on the physical condition of the soil. Plans were also made by Hibbard to extend his investigations to include the effect of rice growing on the chemical and bacteriological condition of the soil. Before the beginning of the experiments, and as an aid in planning the work, W. W. Weir made a reconnaissance and report on the general soil and drainage conditions in the rice areas of the Sacramento Valley.

PREPARATION OF FIELD AND SEEDING

With the exception of the plots which were to have no seed bed preparation, all plots were plowed about four inches deep, double disced, and finally "floated." This treatment gave an excellent seed bed. The standard rate of seeding was 150 pounds. Two plots, however, received 200 pounds per acre in connection with a cat-tail control experiment. An excellent quality of Early Wataribune seed was used throughout the field. Plots not requiring submergence at a later date were planted and submerged by May 1.

Fig. 2.—Rice grown under continuous submergence method. Note freedom from foul growth between levees. Payne and Dozier ranch, Princeton, California, 1921.

EFFECTS OF SEEDING AND SUBMERGENCE ON WATER-GRASS CONTROL

Submergence immediately after broadcasting.—In these experiments the rice was broadcasted and left on the surface of the soil without harrowing. Water was then turned into the plots and brought to the required depth, which was maintained throughout the season. The plan of work included a study of the length of time taken by the seeds to germinate and come to the surface of the water after submergence, and of the effect of depth of submergence on weed control and on the yield of rice.

TABLE 1

SUMMARY OF RESULTS SHOWING EFFECTS OF METHODS OF SEEDING AND DEPTHS OF SUBMERGENCE ON WEED CONTROL AND YIELDS OF RICE

Plots	Method of seeding	Time of submergence	Depth of submergence, inches	Total area, acres	Total yield, pounds	Yield per acre, pounds
60, 41	Broadcasted	May 1, immediately after broadcasting	8	1.14	3162	2766
58, 44	Broadcasted	May 1, immediately after broadcasting	6	1.05	3484	3318
57, 45	Broadcasted	May 1, immediately after broadcasting	4	1.46	3992	2733
53, 47	Broadcasted	May 1, immediately after broadcasting	2	1.56	4002	2565
59, 42	Broadcasted in water	May 1, immediately before broadcasting	8	1.03	2527	2453
56, 40	Broadcasted in water	May 1, immediately before broadcasting	6	.87	1791	2041
55, 46	Broadcasted in water	May 1, immediately before broadcasting	4	1.92	5669	2952
54, 34	Drilled	May 1, immediately after drilling	8	1.19	2807	2358
51, 37	Drilled	May 1, immediately after drilling	6	1.42	2514	1770
52, 38	Drilled	May 1, immediately after drilling	4	1.19	2044	1716
*32, 39	Drilled	30 days after emergence from soil	6	.53	714	1347
50, 33	Drilled	May 24, plants one inch high	8	1.17	2487	2142
49, 35	Drilled	May 24, plants one inch high	6	.88	950	1079
48, 36	Drilled	May 24, plants one inch high	4	1.16	1672	1368

* Used as check plots. First irrigation on May 1, followed by four irrigations prior to submergence. These plots were exceedingly foul.

Weeds began to appear beneath the surface of the water within a month after the plots were submerged. Ten days after the weeds were first noticed a scum appeared on the leaves and many of the plants died.

In the plots submerged eight inches no "barnyard grass" (*Echinochloa crus-galli*) appeared above the surface of the water. There was a scattering of barnyard grass in the plots submerged six inches, while a considerable quantity of grass came through four inches of water. Plots submerged two inches were very foul with barnyard grass. Water weeds other than the various types of barnyard grass

Fig. 3.—Beginning of submergence of rice checks.

were not controlled by continuous submergence to any extent. Figure 2 shows a field on the Payne and Dozier ranch near Princeton in which practically all foul growth was eliminated from the rice checks in 1921 through continuous submergence after seeding.

Broadcasting in water.—The plots in these trials were covered with water to the required depth and the rice broadcasted in the water. The effect on weed control was the same as in the plots submerged after broadcasting.

Submergence immediately after drilling.—The rice in these plots was drilled about one and one-half inches deep. Water was then turned into the plots (fig. 3) and kept at the required depth throughout the season. A very inferior stand of rice resulted, along with a heavy growth of the annual sedge, which aided materially in reducing the yield.

Submergence following germination.—The rice in this experiment was drilled about one and one-half inches deep and irrigated twice before the plants were an inch above the ground, when the plots were submerged to depths of four, six, and eight inches. A great deal of water-grass came through the water, the depth seeming to have no effect, as all plots were equally foul. While there was a good stand at the time the plants were submerged, the stand at maturity was only fair.

EFFECT OF DATE OF SEEDING AND SUBMERGENCE ON WATER-GRASS CONTROL AND RICE YIELDS

Four dates of seeding and submergence were used in this part of the experiments, viz., April 15, May 1, May 15, and June 1. All plots were broadcasted and immediately submerged after seeding to a depth of six inches. The plots seeded early gave distinctly better yields, little difference, if any, being noted in water-grass control. Results as to yields are presented in detail in the following table:

TABLE 2.

SUMMARY SHOWING RESULTS OF EXPERIMENTS ON THE DATE OF SEEDING AND SUBMERGENCE OF RICE; SUBMERGENCE 6 INCHES DEEP

Plots	Date of seeding and submergence	Total area, acres	Total yield, pounds	Yield per acre, pounds	Date of maturing
1, 20	April 15	2.07	7584	3664	Sept. 24
6, 19	May 1	2.75	7037	2558	Sept. 27
14, 16	May 15	1.69	4475	2648	Oct. 2
13, 17	June 1	1.93	3994	2069*	Oct. 9

* Straw short and heads with many blanks.

MISCELLANEOUS EXPERIMENTS

In all the plots concerned in these experiments submergence was completed by May 1.

Cat-tail control by heavy seeding.—Seeding at the rate of 200 pounds per acre resulted in very heavy stands. Cat-tails were not controlled by this method, however, and the stand was too thick for maximum yields. The straw and the heads were very short, though the heads were well filled.

Seed broadcasted on stubble.—Poor stands resulted from this treatment. The straw and heads were short, and weeds other than barnyard grass were very thick. Cat-tail growth was much heavier in these plots than in the rest of the field.

Seed broadcasted in water on rice stubble.—The results from this treatment were very similar to those from the other plots that were not plowed, the cat-tail and weed growth being quite heavy and the yield of rice low.

Cat-tail control by pulling and cutting.—With the exception of plot No. 61, the cat-tails were all cut or pulled by July 15, and were not cut again during the season. The cat-tails in plot No. 61 were cut during the first week in August and were not cut again. This method was used to determine whether the later cutting of cat-tails would have any effect in delaying the growth during the last of the season. It was found this year that the cat-tails were as thick at harvest time in plot No. 61 as in the rest of the field. During the latter part of July and the first of August the rice began to go into the boot and tramping of the rice plants at this time undoubtedly caused considerable injury. The cost of pulling cat-tails over the entire field amounted to $3.48 per acre. The cost for pulling and cutting on land that was not plowed amounted to approximately $5 per acre.

TABLE 3

SUMMARY OF RESULTS OF MISCELLANEOUS EXPERIMENTS

Plots	Treatments	Total area, acres	Total yield, pounds	Yield per acre, pounds
61	Broadcasted then submerged 6 inches. Used to determine proper time to pull cat-tail	1.72	4971	2857
2, 5	Broadcasted at rate of 200 pounds per acre and submerged 6 inches. For prevention of cat-tail growth	1.58	3166	1994
15, 21	Submerged 6 inches after broadcasting on stubble	1.43	2471	1728
12, 18	Submerged rice stubble 6 inches. Broadcasted in water	1.56	1777	1139
22 to 30	Broadcasted and immediate 6-inch submergence	4.38	10136	2312

WATER AND SOIL ANALYSES

P. L. Hibbard furnished the preliminary report of his studies of the rice soils and irrigation water:

Analyses of Waters

Small samples of the water from the canal intake and from the outlet were taken daily and placed in large bottles. A portion was then taken out for analysis. These composite samples show little change throughout the season. All of them are of excellent quality for irrigation. There was a little increase of soluble matter in the intake water during the latter part of the season. The drainage water contained most soluble matter in the early part of the season, when it held 20 to 30 per cent more than the intake water. It is presumed that this increase of soluble matter during the passage of the water through the field is caused by absorption from the saline soils over which it flowed. In the latter part of the season after the available salts had being taken up, the drainage water was almost exactly the same as the intake water in both composition and concentration.

Somewhat random samples were taken from nearby ranches at various times.

Analyses of samples taken from the intake and drain on the Forgues place, June 23, showed the drain water to contain two to three times as much saline matter as the intake water. Samples were again taken from the same field July 14 and August 9. The drain water then contained eight to nine times as much mineral matter as the intake, the intake in both cases being much like that at Cortena.

On the Spalding ranch the same conditions prevailed in the early part of the season as on the Forgues place. However, during the latter part of the season the waters on the Spalding ranch were nearly like those at Cortena.

The water obtained from the intake on the Hardin field on August 9 was good, but the drain water carried seven to ten times as much mineral matter as the intake water.

To summarize, it may be said that when the land is free of alkali, there is little change in the water produced by passing over the rice fields, but when the soil contains soluble salts or alkali some of this matter is carried away in the drainage. How much goes into the subsoil is not known.

ANALYSES OF SOILS

None of the after-harvest samples of soil have been examined, so it is impossible yet to say what effect has been produced by the water used in rice culture.

The soil samples taken before planting showed great variation as to alkali and salts. One hole on new soil (never flooded) showed very little alkali, two other holes had injurious amounts, but not as much as some holes on the old rice land in plot 25. Most of this plot was quite strongly saline and somewhat alkaline. In general, the concentration was higher at the third and fourth foot below than at the surface. Two holes were taken down to twelve feet and showed much the same throughout. On plot 58, there was much less alkaline and saline matter in most places, but considerable quantities still remain in the third and fourth foot. In two holes, carried down twelve feet, there were considerable quantities in all samples below the second foot.

From these statements, it is evident that rice culture on this ground during four preceding years has not yet removed enough of the alkali to make the soil safe for sensitive crops.

PHYSICAL SOIL STUDIES

Chas. F. Shaw furnished the preliminary report on the investigation of the physical condition of these soils:

Samples of soils, representing the Willows clay loam, Willows clay and Stockton clay adobe, were secured from the Colusa and Butte Basins and preliminary studies were made of their physical characteristics. The samples for each soil represented relatively uniform soil conditions, but were taken from adjacent fields, one of which had been in rice, the other in pasture, grain or other crop.

In none of the tests made was there any definite or consistent indication of changes due to the submergence incident to rice culture. The moisture equivalent (water held by the soil against a force of 1000 times gravity) and the hygroscopic coefficient (water absorbed from a saturated atmosphere) show very slight variations. The content of organic matter was fairly uniform throughout all the samples, the total variation being less than one per cent. Tests of the volume weight likewise showed no definite change due to rice culture.

In measuring the degree of contraction that occurs when the soils are dried it was found that in the case of the Willows clay loam and clay the rice soils contracted considerably more than did the similar soils that had been in pasture. The Stockton clay adobe from the rice experiment station at Biggs gave opposite results, the shrinkage of the soils from the rice plots being not over three-fourths as great as that from the soil from a lawn. On comparing the relation between the loss of water and the decrease of volume due to drying, it is found that the Stockton clay adobe which had been in rice lost two grams of water for each cubic centimeter of volume contraction, while the soil from the lawn lost only one and one-half grams per cubic centimeter contraction. The smaller amount of shrinkage in the case of the soils that were in rice is apparently due to the presence of considerable amounts of undecayed rice roots, which served to give the dried soil a more open and porous character.

At the close of the season of 1922 a large number of soil samples were secured, representing soils that had been in rice from one to nine years, and similar soils never in rice. More complete and extensive studies are now under way to determine whether or not any consistent differences in the physical condition of these soils have developed as a result of rice culture.

RICE WEEDS

Pictures of nine different weeds found in the rice fields in 1922, partly at Cortena and partly on other fields in the valley, together with brief descriptions, are shown in the following pages, figures 4 to 13.

Fig. 4.—Tules (*Scirpus occidentalis*). Not especially thick in rice fields. Often found in irrigation and drain ditches. Grows four to fifteen feet high. Seed matures latter part of August. Difficult to control although many growers have been successful with summer-fallow.

Fig. 5.—Spike rush, also known as "wire grass" (*Eleocharis palustris*). Found in corners of checks, ditches, and fields not properly plowed. Grows twelve to eighteen inches high. Matures seed in July. Not controlled by continuous submergence.

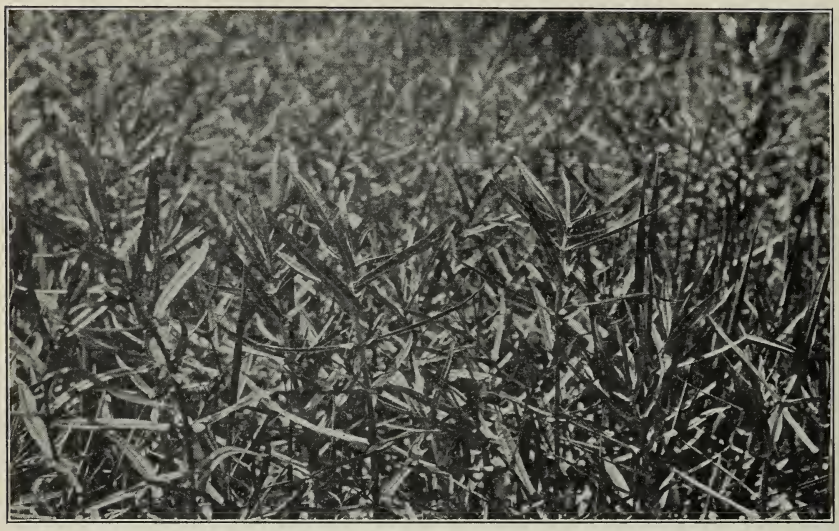

Fig. 6.—Red stem (*Ammania coccinea*). Found in rice fields generally where there is a thin stand of rice. Grows from six inches to three feet high. Matures seed from September 30 to October 30. Not controlled by continuous submergence.

Fig. 7.—Water grass or barnyard grass (*Echinochloa crusgalli*). Found in all parts of the rice area. Probably the most troublesome weed. Grows from one to six feet high. Various types mature seed from June 25 to October 25. Results in 1922 indicate that continuous submergence after seeding will control this weed.

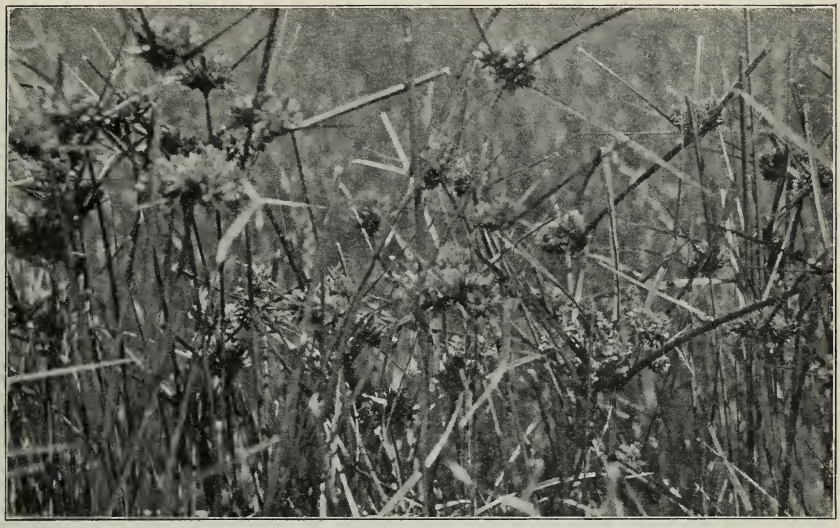

Fig. 8.—Umbrella plant, perennial form (*Cyperus virens*). This form of the cyperus family is seldom harmful except in unplowed places near the rice fields. Grows from one to two feet high. The seed matures the latter part of August. Can be satisfactorily controlled by plowing.

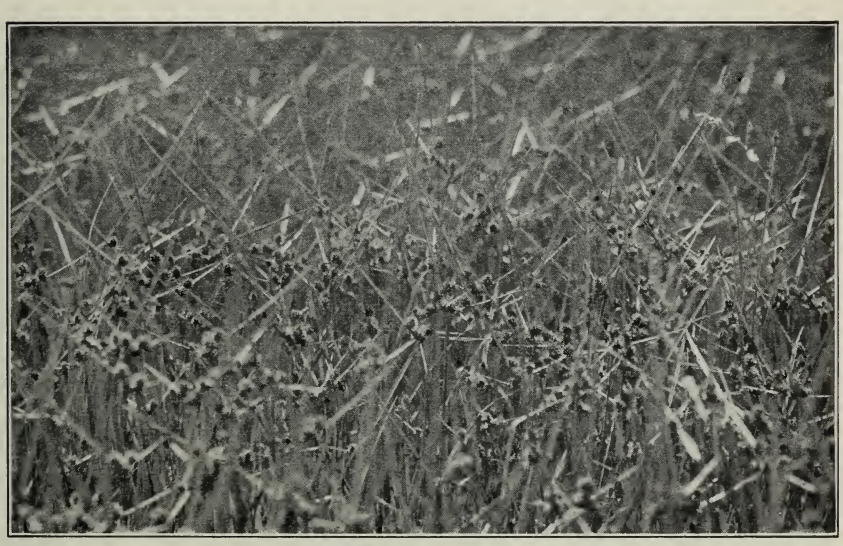

Fig. 9.—Umbrella plant, sometimes known as "annual sedge" (*Cyperus difformis*). This weed was very troublesome at Cortena and several other places in the rice area. It was exceptionally thick in places where the stand of rice was thin. Seldom grows over eighteen inches high. Can probably be held in check by heavy seeding. The seed matures the first part of August. Not controlled by continuous submergence.

Fig. 10.— Crab grass (*Syntherisma sanguinalis*). This is a common grass on ditch banks and levees. It grows one to two feet high. The seed matures the latter part of August. Not especially troublesome in the rice fields.

Fig. 11.—Smart weed (*Polygonium lapathifolium*). This weed is not particularly troublesome in the rice fields at present. It is often seen in the irrigation and drain ditches. Grows about two feet high. Matures seed the latter part of August.

Fig. 12.—Cat-tail (*Typha latifolia*). Sometimes confused with "tule." This perennial plant is becoming a more serious pest each year. The plant grows from four to twelve feet high. Seed matures the latter part of September. Summer-fallow has proved helpful as a means of control.

Fig. 13.—Slender aster (*Aster exilis*). This weed grows mainly in abandoned rice fields and in producing fields that have not been properly plowed. Grows from two to four feet high. Can be controlled by plowing.

STATION PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

BULLETINS

No.

253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California.
261. Melaxuma of the Walnut, "Juglans regia."
262. Citrus Diseases of Florida and Cuba Compared with these of California.
263. Size Grades for Ripe Olives.
268. Growing and Grafting Olive Seedlings.
270. A Comparison of Annual Cropping, Biennial Cropping, and Green Manures on the Yield of Wheat.
273. Preliminary Report on Kearney Vineyard Experimental Drain.
275. The Cultivation of Belladonna in California.
276. The Pomegranate.
278. Grain Sorghums.
279. Irrigation of Rice in California.
280. Irrigation of Alfalfa in the Sacramento Valley.
283. The Olive Insects of California.
285. The Milk Goat in California.
286. Commercial Fertilizers.
287. Vinegar from Waste Fruits.
294. Bean Culture in California.
297. The Almond in California.
298. Seedless Raisin Grapes.
299. The Use of Lumber on California Farms.
304. A study on the Effects of Freezes on Citrus in California.
308. I. Fumigation with Liquid Hydrocyanic Acid. II. Physical and Chemical Properties of Liquid Hydrocyanic Acid.
310. Plum Pollination.
312. Mariout Barley.
313. Pruning Young Deciduous Fruit Trees.
316. The Kaki or Oriental Persimmon.
317. Selections of Stocks in Citrus Propagation.

No.

319. Caprifigs and Caprification.
321. Commercial Production of Grape Syrup.
324. Storage of Perishable Fruit at Freezing Temperatures.
325. Rice Irrigation Measurements and Experiments in Sacramento Valley, 1914–1919.
328. Prune Growing in California.
330. Dehydration of Fruits.
331. Phylloxera-Resistant Stocks.
332. Walnut Culture in California.
334. Preliminary Volume Tables for Second-Growth Redwoods.
335. Cocoanut Meal as a Feed for Dairy Cows and Other Livestock.
336. The Preparation of Nicotine Dust as an Insecticide.
337. Some Factors of Dehydrater Efficiency.
339. The Relative Cost of Making Logs from Small and Large Timber.
340. Control of the Pocket Gopher in California.
341. Studies on Irrigation of Citrus Groves.
342. Hog Feeding Experiments.
343. Cheese Pests and Their Control.
344. Cold Storage as an Aid to the Marketing of Plums.
345. Fertilizer Experiments with Citrus Trees.
346. Almond Pollination.
347. The Control of Red Spiders in Deciduous Orchards.
348. Pruning Young Olive Trees.
352. Further Experiments in Plum Pollination.
353. Bovine Infectious Abortion.
354. Results of Rice Experiments in 1922.

CIRCULARS

No.

70. Observations on the Status of Corn Growing in California.
82. The Common Ground Squirrel of California.
87. Alfalfa.
110. Green Manuring in California.
111. The Use of Lime and Gypsum on California Soils.
113. Correspondence Courses in Agriculture.
126. Spraying for the Grape Leaf Hopper.
127. House Fumigation.
136. *Melilotus indica* as a Green-Manure Crop for California.
144. Oidium or Powdery Mildew of the Vine.
148. "Lungworms."
151. Feeding and Management of Hogs.
152. Some Observations on the Bulk Handling of Grain in California.
155. Bovine Tuberculosis.
157. Control of the Pear Scab.
159. Agriculture in the Imperial Valley.
160. Lettuce Growing in California.
161. Potatoes in California.
164. Small Fruit Culture in California.
165. Fundamentals of Sugar Beet Culture under California Conditions.
166. The Country Farm Bureau.
167. Feeding Stuffs of Minor Importance.
169. The 1918 Grain Crop.
170. Fertilizing California Soils for the 1918 Crop.

No.

172. Wheat Culture.
173. The Construction of the Wood-Hoop Silo.
174. Farm Drainage Methods.
175. Progress Report on the Marketing and Distribution of Milk.
178. The Packing of Apples in California.
179. Factors of Importance in Producing Milk of Low Bacterial Count.
181. Control of the California Ground Squirrel.
182. Extending the Area of Irrigated Wheat in California for 1918.
183. Infectious Abortion in Cows.
184. A Flock of Sheep on the Farm.
188. Lambing Sheds.
189. Winter Forage Crops.
190. Agriculture Clubs in California.
193. A Study of Farm Labor in California.
198. Syrup from Sweet Sorghum.
199. Onion Growing in California.
201. Helpful Hints to Hog Raisers.
202. County Organizations for Rural Fire Control.
203. Peat as a Manure Substitute.
205. Blackleg.
206. Jack Cheese.
208. Summary of the Annual Reports of the Farm Advisors of California.
209. The Function of the Farm Bureau.
210. Suggestions to the Settler in California.

No.

212. Salvaging Rain-Damaged Prunes.
214. Seed Treatment for the Prevention of Cereal Smuts.
215. Feeding Dairy Cows in California.
217. Methods for Marketing Vegetables in California.
218. Advanced Registry Testing of Dairy Cows.
219. The Present Status of Alkali.
224. Control of the Brown Apricot Scale and the Italian Pear Scale on Deciduous Fruit Trees.
225. Propagation of Vines.
228. Vineyard Irrigation in Arid Climates.
230. Testing Milk, Cream, and Skim Milk for Butterfat.
232. Harvesting and Handling California Cherries for Eastern Shipment.
233. Artificial Incubation.
234. Winter Injury to Young Walnut Trees during 1921–22.
235. Soil Analysis and Soil and Plant Interrelations.
236. The Common Hawks and Owls of California from the Standpoint of the Rancher.
237. Directions for the Tanning and Dressing of Furs.

No.

238. The Apricot in California.
239. Harvesting and Handling Apricots and Plums for Eastern Shipment.
240. Harvesting and Handling Pears for Eastern Shipment.
241. Harvesting and Handling Peaches for Eastern Shipment.
242. Poultry Feeding.
244. Central Wire Bracing for Fruit Trees.
245. Vine Pruning Systems.
246. Desirable Qualities of California Barley for Export.
247. Colonization and Rural Development.
248. Some Common Errors in Vine Pruning and Their Remedies.
249. Replacing Missing Vines.
250. Measurement of Irrigation Water on the Farm.
251. Recommendations Concerning the Common Diseases and Parasites of Poultry in California.
252. Supports for Vines.
253. Vineyard Plans.
254. The Use of Artificial Light to Increase Winter Egg Production.
255. Leguminous Plants as Organic Fertilizer in California Agriculture.
256. The Control of Wild Morning Glory.